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Blaha

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[54] **DAMPED AIR DISPLACEMENT SUPPORT SYSTEM**

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[*] Notice: The portion of the term of this patent subsequent to Aug. 3, 2010 has been disclaimed.

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[51] **Int. Cl.**^{5} **A47C 27/14**

[52] **U.S. Cl.** **5/481**; 5/450

[58] **Field of Search** 5/481, 450, 480, 464, 5/468

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Assistant Examiner—Flemming Saether
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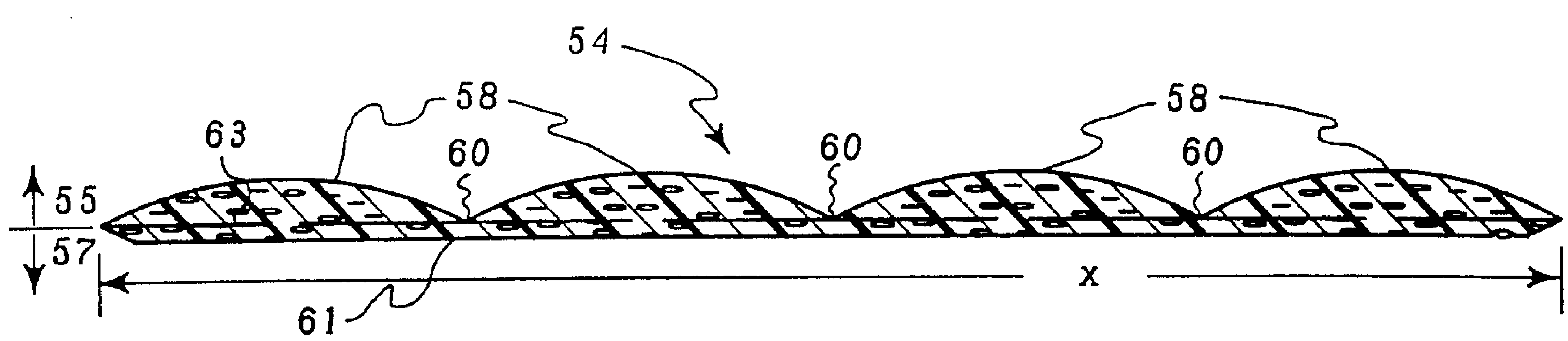
[57] **ABSTRACT**

A damped gas displacement support system which includes an envelope of flexible, gas impervious material and a core of partially compressed, flexible cellular material occupying the space within the envelope, the cellular material compression being sufficient to establish a partial vacuum therein. When force is applied to the cell the partially compressed and partially evacuated core instantly seeks equilibrium about that area of the envelope receiving the applied force. Various system embodiments are described and illustrated, along with a preferred method for manufacturing the support cell.

20 Claims, 7 Drawing Sheets



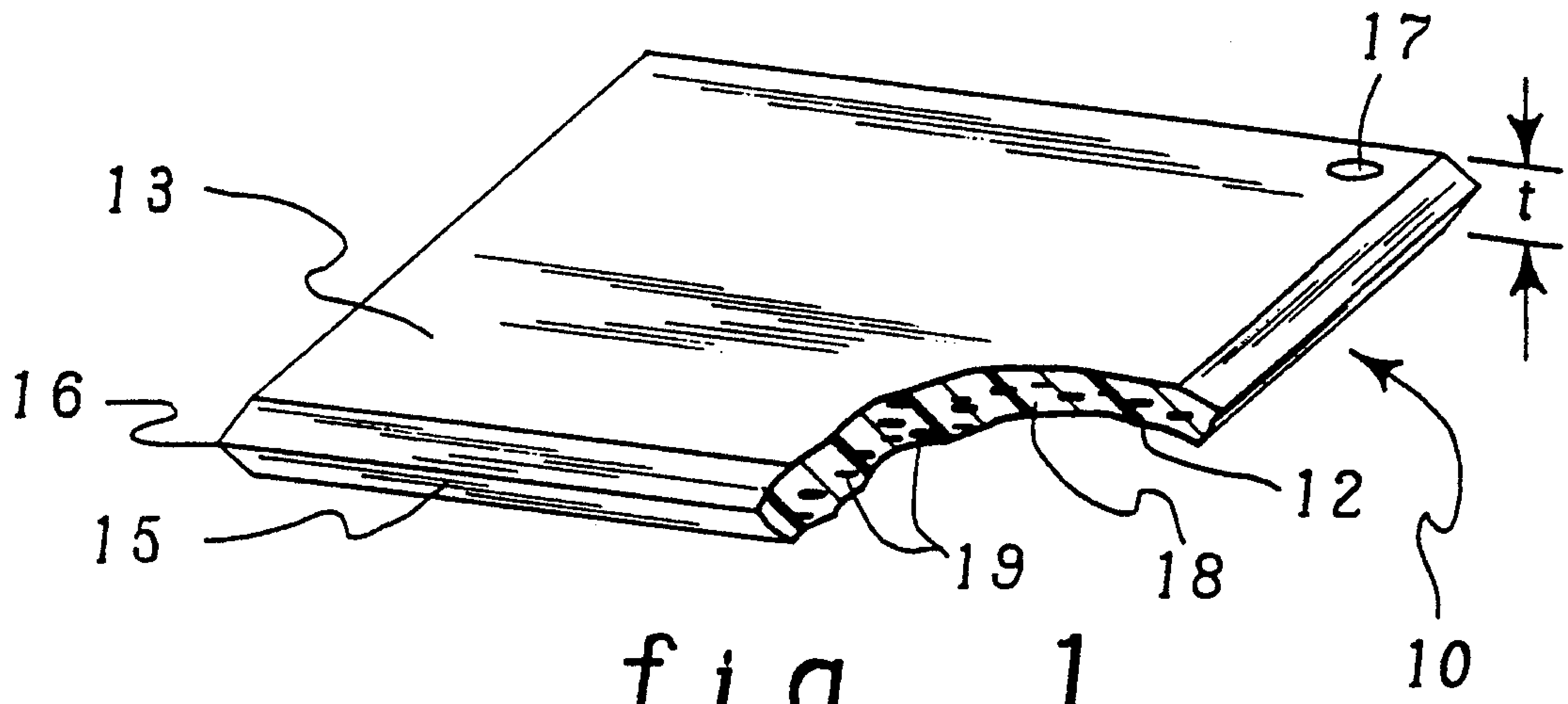


fig. 1

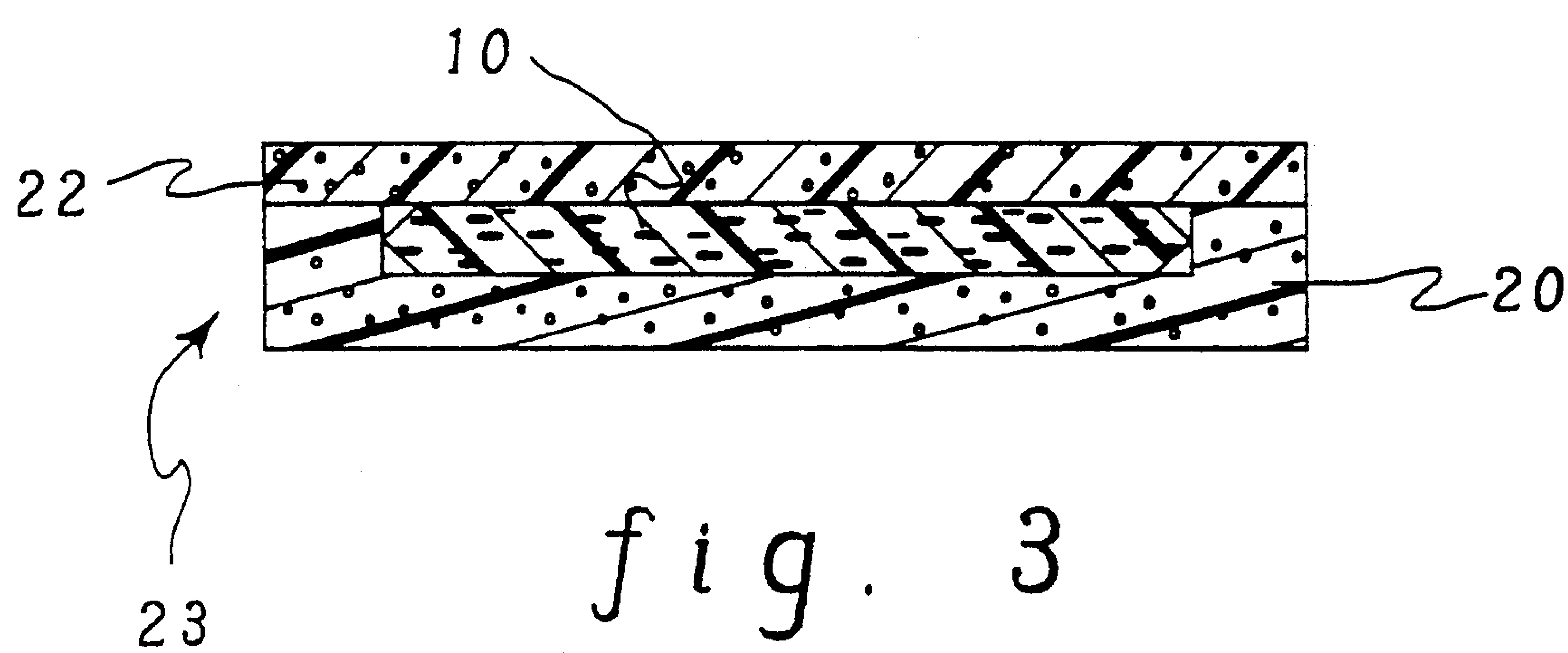


fig. 3

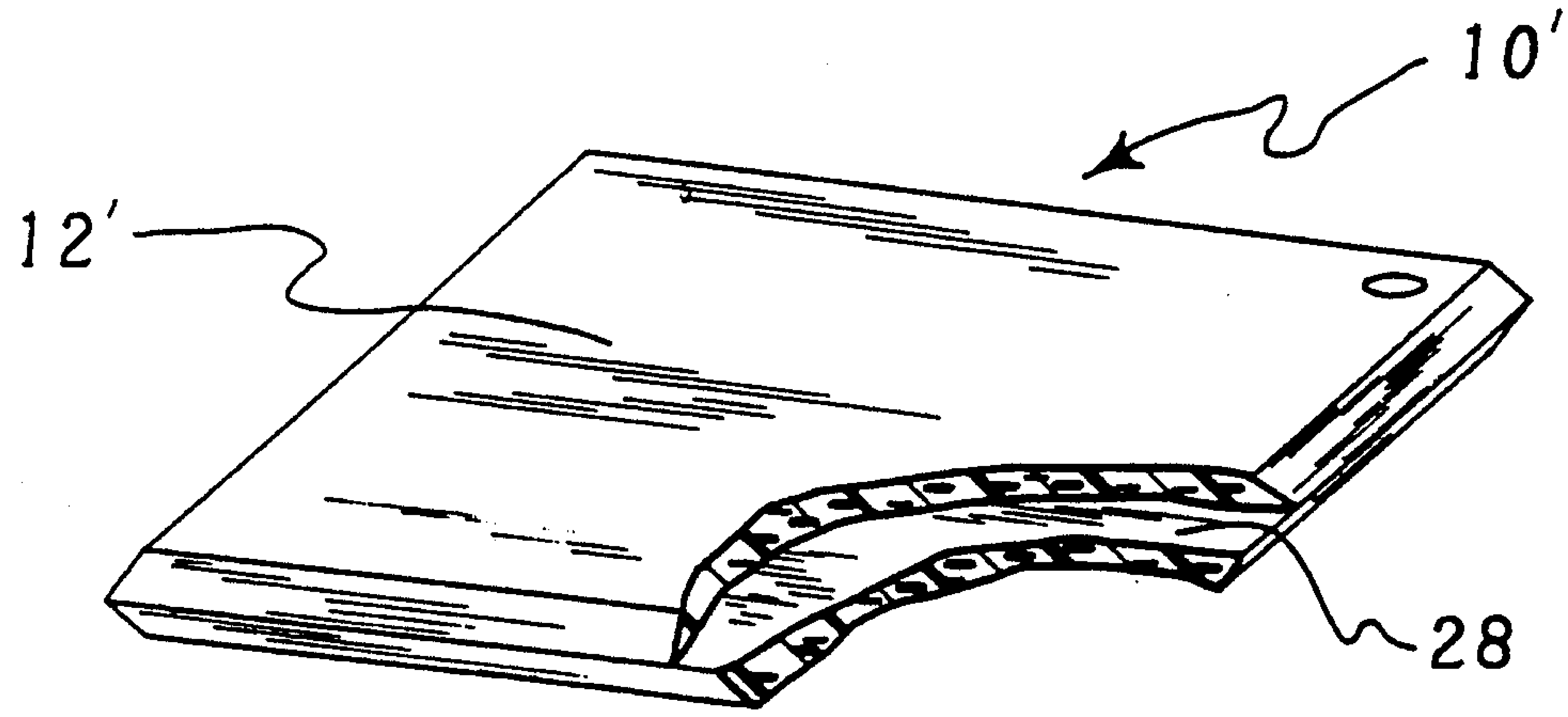


fig. 4

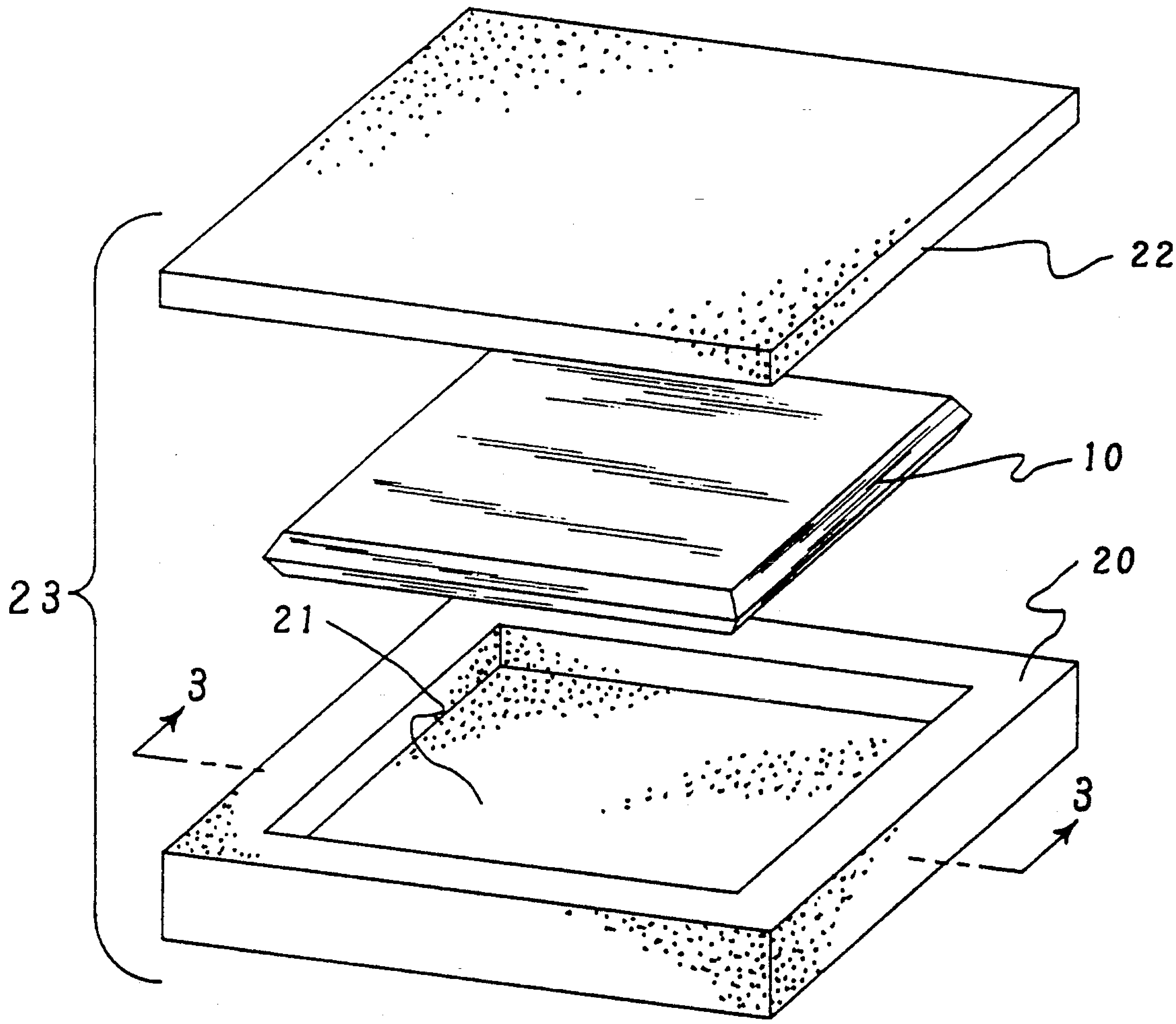


fig. 2

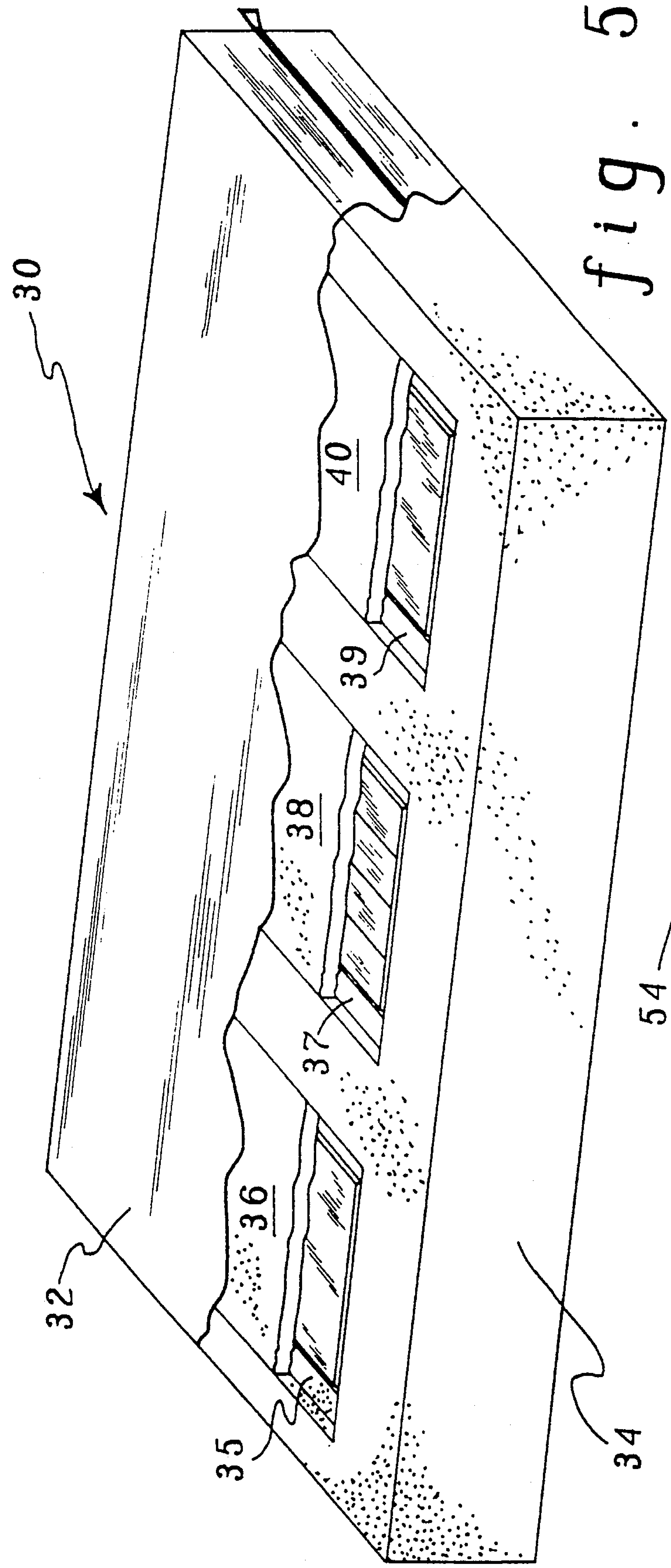


fig. 5

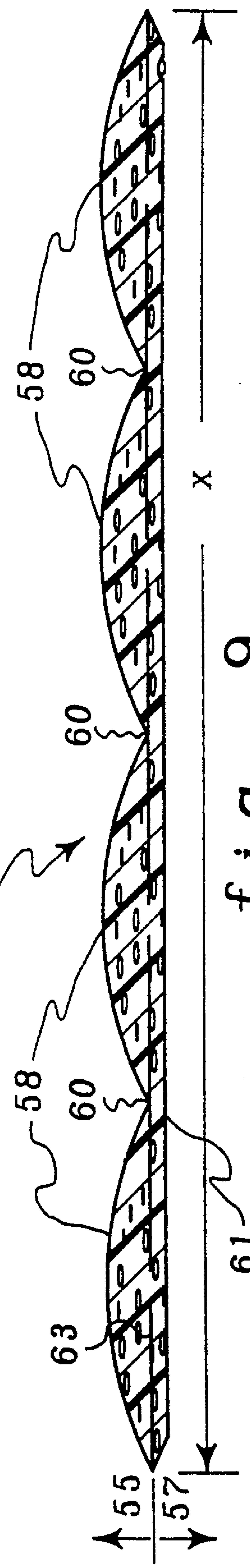


fig. 9

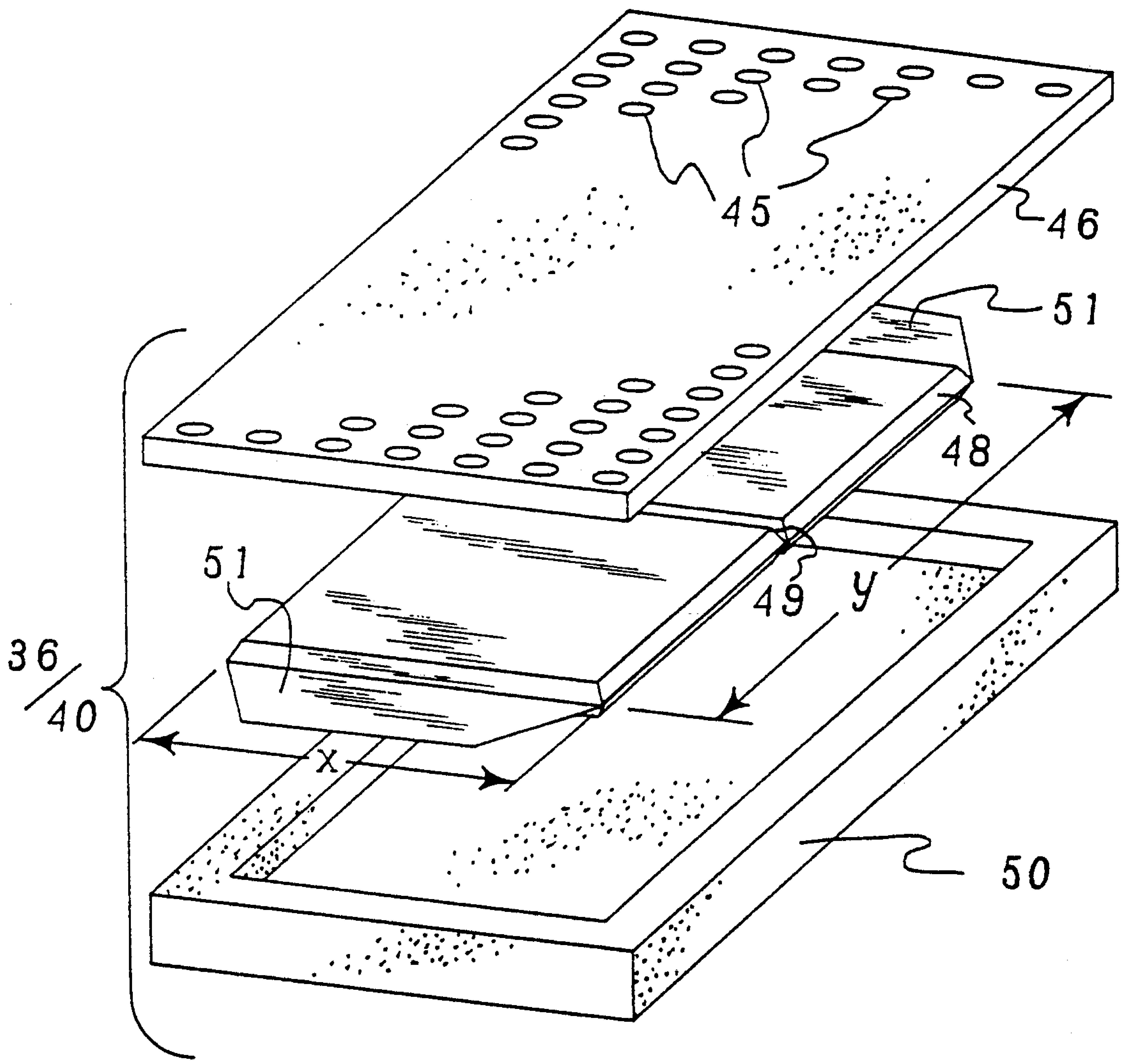


fig. 6

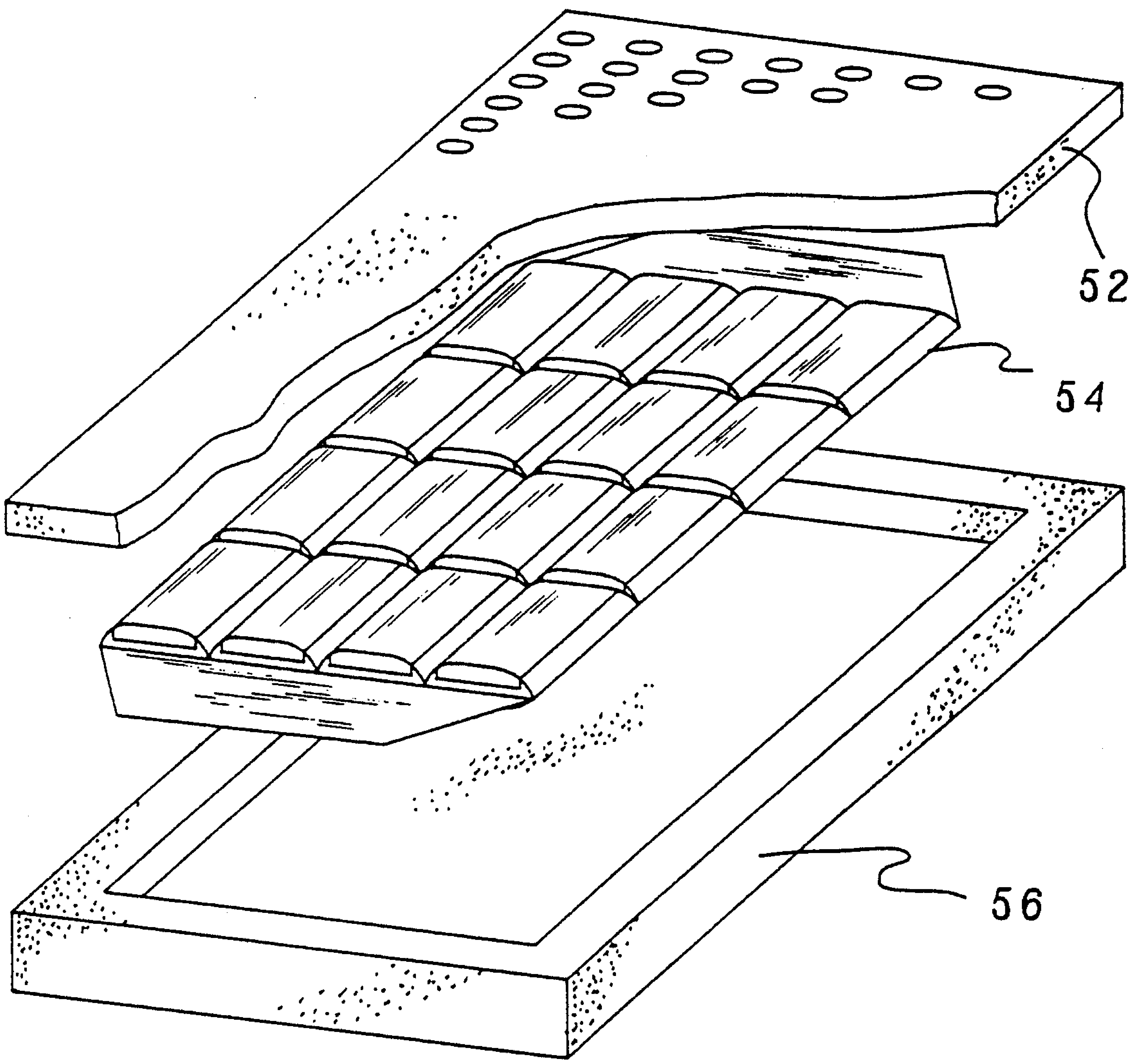


fig. 7

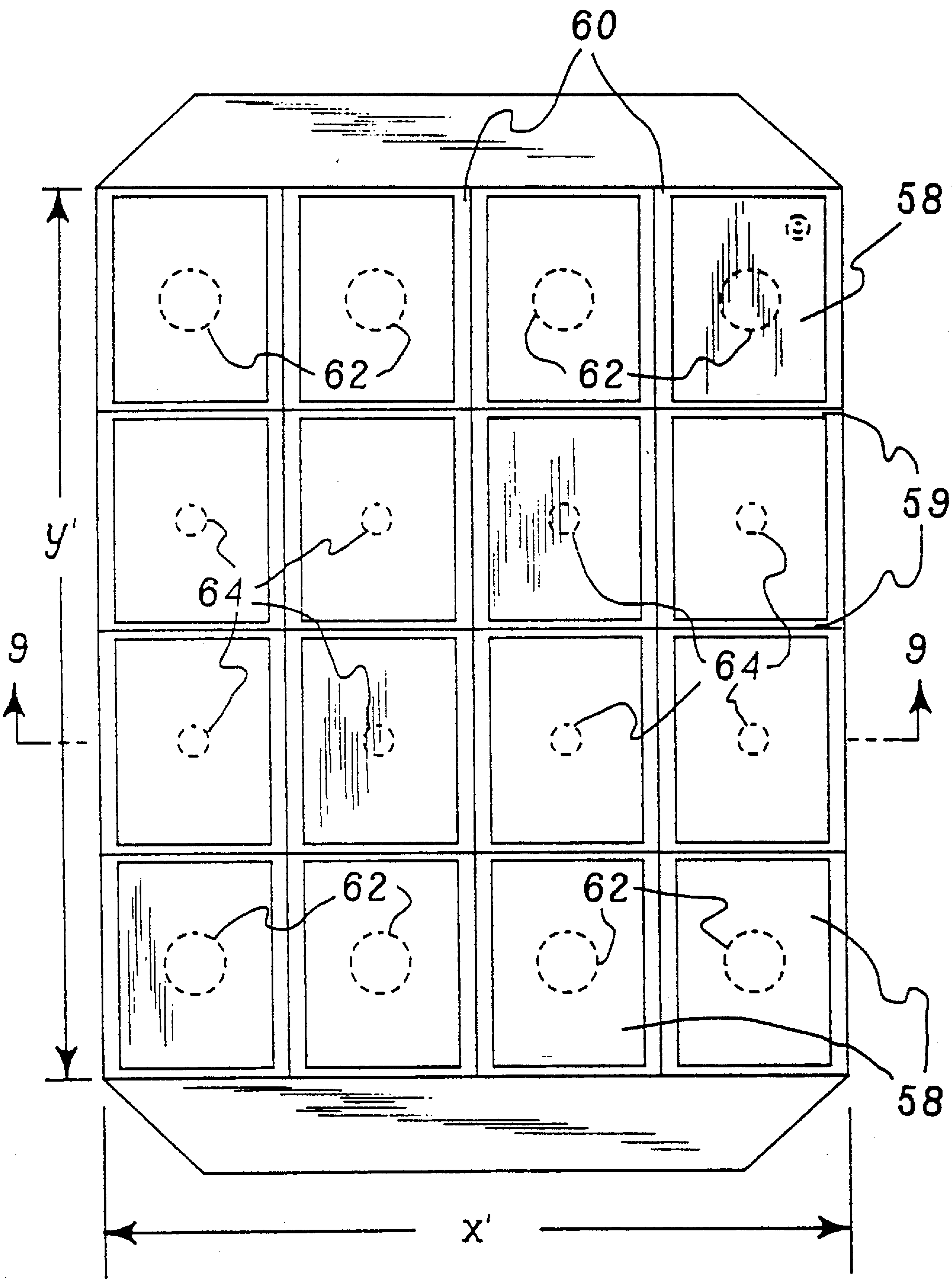


fig. 8

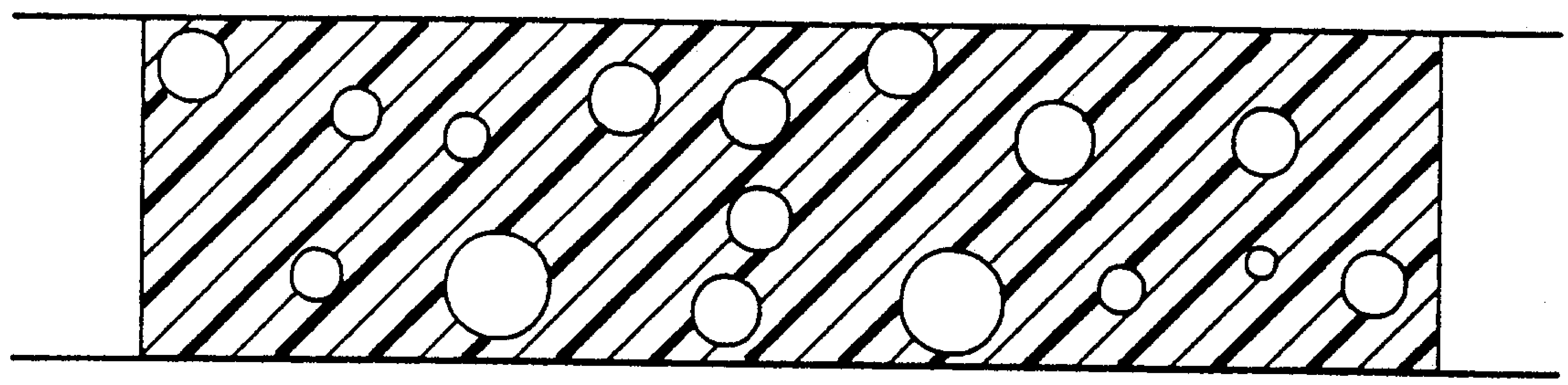


fig. 10a

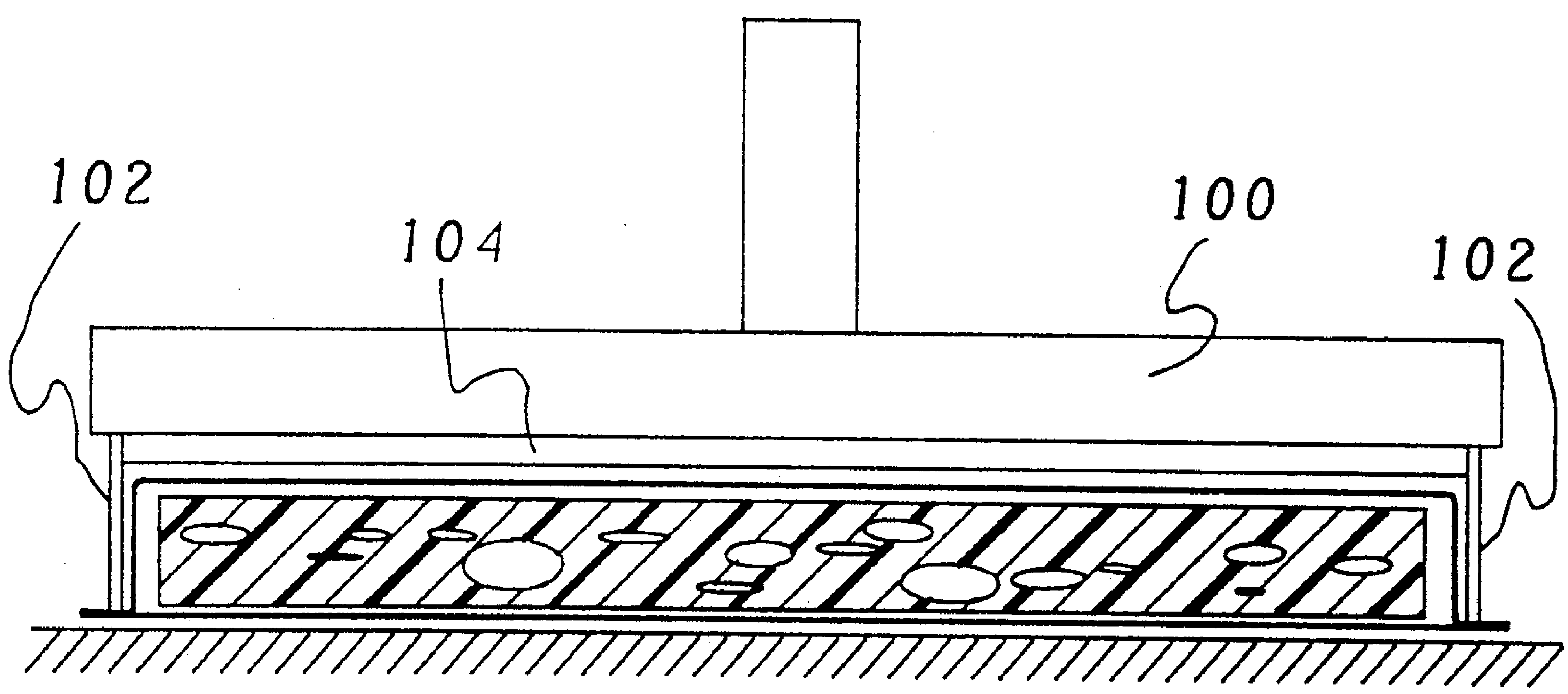


fig. 10b

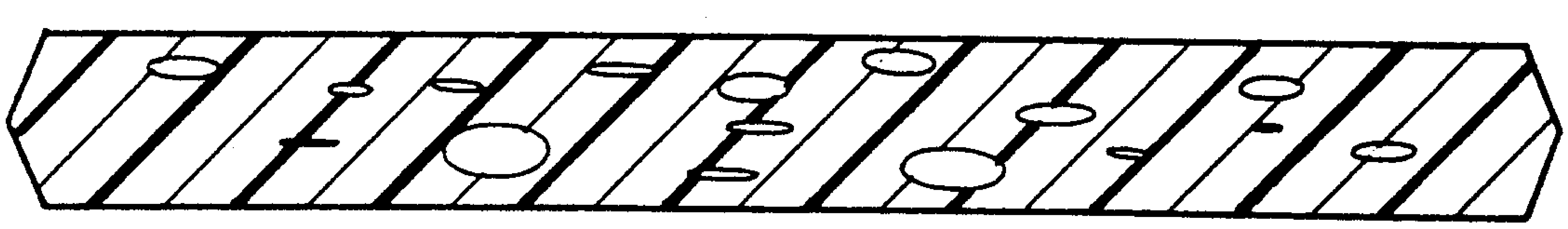


fig. 10c

DAMPED AIR DISPLACEMENT SUPPORT SYSTEM

BACKGROUND OF THE INVENTION

1. Technical Field

This invention relates to support systems, and more particularly, to systems such as mattresses, cushions, upholstery padding and the like having a resilient cellular material therein and to methods for manufacturing the same.

2. Description of the Prior Art

Many support systems exist within the art which attempt to provide pressure relief for an individual. A trade-off typically occurs in all such systems between comfort, stability and weight in order to achieve a marketable device. For example, support systems which contain liquid, such as waterbeds and water filled cushions, have various support benefits which are well known. On the other hand, such systems also exhibit many disadvantages. In particular, conventional waterbeds and water filled cushions produce a kind of wave action or rolling motion when in use due the tendency of water or other liquid inside the system to rush rapidly from one part thereof to another when an individual places his weight thereon, thereby forcing the liquid to flow to another part of the system. Moreover, since the envelope containing the liquid in such a system is typically elastically yieldable, a reaction to an initial liquid surge occurs. This reaction often results in a succession of countersurges within the envelope until the system reaches equilibrium. The described undamped surging and countersurging of the liquid in such systems is annoying to most users thereof. In order to obviate the above mentioned disadvantages, many waterbed manufacturers do not employ liquid displacement in that portion of the system which is intended to support the head and shoulders of the user. Instead, they employ a section of mattressing constructed in the conventional manner utilizing coil springs or other equivalent non-liquid structures. Obviously, this introduces an element of complexity to the manufacturing process and, as well, increased costs. Other manufacturers have attempted to dampen waterbed wave motion in various ways. In U.S. Pat. No. 3,585,356 the use of solid particles, such as Styrofoam ®, are disposed in liquid for this purpose. U.S. Pat. No. 3,736,604 uses flap means, as illustrated in FIG. **11** therein.

Saloff et al. describe in U.S. Pat. Nos. 4,942,634 and 4,370,768 (entitled "Damped Fluid Displacement Support System and Method for Making the Same" and "Damped Fluid Displacement Support System," respectively, both of which are assigned to the same assignee as the present invention) substantially completely stable damped liquid displacement support systems. In these systems, a core of resilient liquid absorbent material is disposed within a liquid impervious sealed envelope, the core being saturated with a liquid. When force is applied to the system the liquid within the cell migrates from one portion thereof to another before coming to equilibrium about the applied force. The foam core prevents the liquid from rushing from one region where pressure is applied to another region in the support cell. Thus, movement of the fluid within the cell is "damped" Further, the amount of water available to be displaced within the cell is less than one would find in a conventional system and, therefore, the damped liquid system weighs less than a conventional system.

Notwithstanding the commercial success of this damped system, certain drawbacks inherent in the liquid construction remain. For example, although lighter than preexisting liquid support systems, the jell or water used therein necessarily makes the weight of the system a consideration for many individuals who may wish to own such a device. Further, although better than conventional water support systems, a period of time is required before the damped liquid support system achieves equilibrium about an applied force, during which time there may be a feeling of instability in the individual using the system.

Non-liquid filled support systems, such as air filled mattress or cushion cells, are also typically unstable when pressure is applied thereto. In addition, such systems provide pressure relieving support characteristics generally inferior to those available with water filled systems.

Thus, there continues to exist a need for a new type of support system which achieves greater comfort and stability with less weight than presently available body support systems, while still providing comparable or superior pressure relieving support.

SUMMARY OF THE INVENTION

Briefly summarized, the present invention comprises in one broad aspect a support cell having an envelope of flexible material within which a core of partially compressed, flexible cellular material is located. The compression of the core cellular material is sufficient to establish a partial vacuum within the envelope such that when force is applied to the cell the core instantly seeks equilibrium about that area of the envelope receiving the applied force.

In a further embodiment, the invention comprises a damped gas displacement support system which includes an envelope of flexible gas impervious material having two substantially parallel panels of substantially the same size. Each panel has a boarder surface, and the boarder surfaces of the panels are sealed together in a gas impervious seam. One of the panels serves as a body supporting surface. The envelope has a core of partially compressed, resilient, gas-absorbent cellular material occupying the space defined thereby. The core is maintained in its partially compressed state by the panels of the envelope. Lastly, a gas is constrained within and partially fills the cellular material such that the envelope immediately seeks equilibrium about that portion of the individual's body contacting the body supporting surface.

In an enhanced version, the system embodiment further includes a relatively thick resilient material surrounding the envelope, which together define either a mattress or a cushion. Further, and depending upon the implementation, a wall may be used to divide the interior of the envelope into multiple compartments, each compartment being occupied by the partially compressed, flexible cellular material with the gas partially constrained therein. Again, depending upon the desired response characteristics, one or more openings in the divider wall may be provided for communication of constrained gas or air therebetween. Other specific enhancements are described and claimed herein.

Lastly, a method for making the novel damped air displacement support cell of the present invention is set forth. The method includes the steps of: forming a stack by placing a core of resilient air-absorbent material between two panels of air impervious material, the panels being sized to form an envelope once sealed together, and the resilient air-absorbent material being sized to overfill the envelope once the panels are sealed together; partially compressing the stack to force a portion of the air constrained therein from the resilient air-absorbent material; and sealing the panels together in an air impervious seam to form the envelope while maintaining the stack in its partially compressed condition.

The cell system of the present invention described herein may be used to provide greater comfort and stability, with less package weight than preexisting body supporting techniques. The cell/system described herein has the unique feature of instantly contouring to a body to provide pressure relief, but in such a way that stability is never jeopardized. This is accomplished by applicant's unique foam overfilling and vacuum creation combination. The cell/system is far superior to preexisting systems which typically, for example, suffer from wave effect and/or promote an unstable feeling when pressure is applied thereto.

BRIEF DESCRIPTION OF THE DRAWINGS

These and other objects, advantages and features of the present invention will be more fully understood from the following detailed description of certain embodiments thereof when considered in conjunction with the accompanying drawings in which:

FIG. **1** is a partially cutaway perspective view of one embodiment of a damped air displacement support cell pursuant to the present invention;

FIG. **2** is an exploded perspective view of one embodiment of a cushion assembly pursuant to the present invention which incorporates the damped air displacement support cell of FIG. **1**;

FIG. **3** is an assembled, cross-sectional view of the cushion assembly of FIG. **2** taken along lines **3—3**;

FIG. **4** is a partially cutaway perspective view of an alternate embodiment of a damped air displacement support cell pursuant to the present invention;

FIG. **5** is a partially cutaway perspective view of one embodiment of a mattress assembly pursuant to the present invention;

FIG. **6** is an exploded perspective view of an end cushion assembly used in a mattress assembly of the subject invention;

FIG. **7** is a partially cutaway exploded perspective view of a center cushion assembly used in a mattress assembly of the subject invention;

FIG. **8** is a top plan view of the damped air displacement support cell of the center cushion assembly of FIG. **7**;

FIG. **9** is a cross-sectional view of the damped air displacement support cell of FIG. **8** taken along lines **9—9**; and

FIGS. **10***a*–**10***c* illustrate one method for manufacturing the damped air displacement support cell of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

One basic embodiment of a damped air displacement support cell **10** pursuant to the present invention is shown in FIG. **1**. Cell **10** includes a flexible envelope **12** formed by heat sealing together upper and lower panels **13** & **15**, respectively, along a circumferential seam **16**. Envelope **12** comprises a gas impervious material such as a high quality "pool grade vinyl". The vinyl has a thickness of about 0.020 inch, and a cold crack resistance of at least about minus 20° Fahrenheit. Further, the vinyl has properties that permit panels 13 & 15 to be readily fused together by standard dielectric heating techniques.

A valve **17** is mounted in panel **13** of envelope **12** to permit communication between the interior of the envelope and its ambience in order to evacuate gases therein pursuant to one embodiment of the present invention. The valve is of the positive closing type and in this respect it has been found that Type 1020 AF manufactured by Halkey-Roberts is suitable for this purpose. In an alternate embodiment, (manufactured as described below with reference to FIG. **10***a*–**10***c*) no value is included within the envelope, wherein fusion of the upper and lower panels along their circumferential seam produces a permanently sealed, gas impervious envelope.

A core of resilient, partially compressed, gas-absorbent cellular material **18** (e.g., polyurethane foam) occupies the space within envelope **12**. Cellular material **18** is maintained in its partially compressed state by panels **13** & **15** of envelope **12**. In effect, "extra" cellular material is positioned within the envelope. Material **18**, which is preferably compressed in the range of 5 percent to 50 percent its normal dimensions, has a gas (or gaseous mixture such as air) constrained within a portion of its cellular structure, such as compressed cells **19**. As described further below, certain cells of the cellular structure are also evacuated.

The degree of material **18** compression depends upon desired support/response characteristics of the cell, along with characteristics of the particular cellular material used. For example, those skilled in the art will recognize that low density polyurethane foam, such as 1.2 lb. foam, requires greater compression than a medium density foam, e.g., 1.6 lb. foam, to produce the same support and response characteristics. Similarly, a medium density foam requires a greater percent compression than high density foam to produce comparable response characteristics. By way of example, if the desired thickness "t" of envelope **10** is approximately 1 inch, and a medium density cellular material, such as 1.6 lb. polyurethane foam, is used, then material **18** may have an uncompressed thickness of 1.25 inches, meaning the material is compressed roughly 25 percent when sealed within the envelope. The extent of compression may vary between implementations, but the concept of maintaining cellular material in a compressed state in the resultant structure is a significant feature of the present invention.

As noted, a gas or gas mixture such as air, also occupies part of the space within envelope **12**. For ease of cell manufacture air is presently preferred as the gas medium to be constrained within the open cellular structure of partially compressed material **18**. Note that partial compression of material **18** typically produces a partial evacuation of air from certain cells of the open cellular structure. Thus, when force is applied to the support cell changing the envelope's configuration, these evacuated cells have the capacity to expand and accept air from other parts of the envelope. This transfer of air within the envelope occurs substantially instantaneously, at least in comparison with conventional liquid support systems. Further, the extra foam material within the envelope results in a much softer support system than preexisting support systems.

During one preferred manufacturing method (described below) for cell **10**, simultaneous with compression of cellular material **18**, a certain percentage of the air constrained within the cellular material is allowed to escape or evacuate therefrom. Thus, once sealed the core of envelope **12** is partially evacuated such that when force is applied thereto air within the cellular structure propagates through material **18** and the material readily contours to obtain an equilibrium configuration about the applied force. If desired, envelope **12** can be further evacuated, for example, through valve **17**, to create a greater vacuum within its core and therefore different response characteristics. Again depending upon the density of the cellular material selected and the desired support/response characteristics of the cell, the core of envelope **12** is typically evacuated in the range of 5 percent to 50 percent.

The combination of partial compression of material and partial evacuation of gas from the cellular material within envelope **12** provides cell **10** with significant performance advantages over previously known products. For example, for such a relatively simple construction, immediate response and impressive stability exists with the support cell of FIG. **1** when pressure is applied thereto, that is, when an individual's body contacts a supporting surface (one of the envelope defining panels). When pressure is applied to one of the surfaces of the cell, the cell adjust at the point of contact substantially instantly since the interior core of the cell is under vacuum. Further performance advantage is provided by the compressed foam material within cell **10** which also expands substantially instantaneously when given the opportunity, i.e., to reconfigure the cell about the applied force.

One use for cell **10** is depicted in the cushion assembly **23** of FIGS. **2** & **3**. In this embodiment, cell **10** is accommodated within an opening **21** defined in a base frame **20**, and is retained therein by a top structure **22**, which is preferably glued to base frame **20**. Base **20** and top **22** are constructed of a resilient material, such as urethane foam of appropriate density. By way of example the base and top of cushion **23** may comprise 2.2 lb. and 1.9 lb. foam, respectively. This cushion structure is particularly useful as a base or back cushion for a conventional chair or for the base or back support surface of a wheelchair.

Alternate embodiments of the damped air displacement cell of the present invention may also be constructed. For example, in the cell **10'** embodiment depicted in FIG. **4**, a core divider **28** positioned substantially parallel to the upper and lower panels of envelope **12'** is provided. In this embodiment, divider **28** functions to further throttle the flow of gas and the reconfiguration of material within the cell, i.e., in response to an applied force, by dividing the core into multiple compartments. If desired, one or more openings, for example peripherally located openings (not shown), may be provided in divider **28** to allow the communication of gas constrained within the different cell compartments to communicate therebetween. Further and more intricate modifications to the basic cell structure of FIG. **1** are described below with reference to accompanying FIGS. **5-9**.

FIG. **5** depicts one configuration of the present invention useful as a mattress **30**. Mattress **30** has a casing **32** manufactured of any suitable material generally used for mattresses. The material must be soft and have enough stretchability so as not to restrict the action of the invention as described herein. Preferably, a zipper **31** is provided to facilitate removal of casing **32** from mattress **30** for cleaning or replacement.

In the embodiment shown, a flexible foam frame structure **34** (e.g., 1.9-2.2 lb. polyurethane foam) defines three similar sized openings **35**, **37** & **39** which accommodate cushions assemblies **36**, **38** & **40**, respectively. As with the cushion embodiment of FIGS. **2** & **3**, each cushion assembly **36**, **38** & **40** includes a foam frame having a base and a top, along with an inner cell manufactured pursuant to the present invention. Depending on the mattress size desired, e.g., twin vs. king size, mattress **30**, cover **32** and frame **34** may be configured to accommodate one, or two or more side by side positioned cushion assemblies **36**, **38** & **40**. Assemblies **36**, **38** & **40** are each dimensioned to fit within the corresponding openings **35**, **37** & **39**, respectively, provided within frame **34**.

In one implementation, cushion assemblies **36** & **40** (referred to herein as "end cushions") are identically constructed. One embodiment for the end cushion assembly is depicted in FIG. **6**, while a preferred embodiment for cushion assembly **38** (referred to herein as a "center cushion") is depicted in FIGS. **7-9**.

Referring first to FIG. **6**, the end cushion assembly **36/40** is shown in exploded view. The end cushion includes a top panel **46**, a damped air displacement support cell **48** and a bottom supporting frame **50**. Top panel **46** and bottom frame **50** are each manufactured of a flexible foam material, such as that described above with reference to FIGS. **2** & **3**. A plurality of holes **45** are provided in top panel **46** to facilitate the dispersement of heat generated within the assembly.

Cell **48** is essentially constructed as described above with reference to cell **10** of FIG. **1**. However as shown, cell **48** also includes a centrally located transverse seam **49**, which divides the cell into two separate compartments, and oppositely extending tabs **51** from the main body of cell **48**. Seam **49** is formed, for example, by heat sealing the upper and lower panels of the cell's envelope together along a transverse line. Alternatively, a longitudinal seam (not shown) in cell **48** could be substituted for seam **49**, as could various other combinations of compartment defining seams. Multiple cell compartments are desirable when the size of the cell becomes relatively large, for example, twenty inches or more in width "x" and/or length "y". This prevents the undue collection of gas (air) and/or material (foam) in any one portion of the cell when a force is applied to another part thereof.

As noted, one embodiment of center cushion assembly **38** is shown in FIGS. **7-9**. Assembly **38** includes a top panel **52**, a center cell **54** and a base frame **56**. The assembly is sized to fit within the opening **37** in the mattress frame structure **34** (see FIG. **5**). Top **52** and base **56** are, again, each manufactured of a flexible foam material such as that described above with respect to the end cushion assembly. The significant difference between assembly **38** and end cushion assemblies **36** & **40** is in the design of the inner cell **54** in comparison with cell **48** (FIG. **6**).

As best shown in FIG. **9**, cell **54** is divided into an upper section **55** and a lower section **57**. Section **55** is further divided into a plurality of compartments **58** by transverse seams **59** (see FIG. **8**) and longitudinal seams **60**. In one preferred embodiment, lower section **57** comprises one large compartment of width "x'" and length "y'" (FIG. **8**), and having a relatively high density cellular material therein in a compressed state. As a specific example, for a twin size mattress, dimensions x' and y' may be **23** and **29** inches, respectively; and the cellular material positioned in lower section **57** may comprise **2.2** lb. foam. The high density foam is maintained compressed in cell **54** by lower panel **61** and an interior divider **63** (FIG. **9**) between which the foam is positioned. The multiple compartments of upper section **55** each include a medium density cellular material, which again pursuant to the invention is in a partially compressed state and partially evacuated of air or other gas constrained therein. Preferably, the various compartments of upper section **55** and the compartment of lower section **57** communicate with one another through one or more ports. In the embodiment illustrated, a centrally located port is provided in the interior divider for each upper section compartment **58**. The lengthwise outer compartments (see FIG. **8**) each include a larger stabilization port **62** while the longitudinally inner compartments each have a smaller communication port **64**. Ports **62** and **64** are shown in phantom in FIG. **8**. By providing larger openings at the outer compartments, a person lying near the middle of mattress **30** (FIG. **5**) tends to be cradled as a result of air/-foam movement within cell **54** of cushion assembly **38** and cells **48** of cushion assemblies **36** & **40**.

In accordance with the invention there is also provided an efficient method for making a damped air displacement support system which includes: forming a stack by placing a core of resilient air-absorbent material between two panels of air impervious material, the two panels being sized to form an envelope once sealed, and the resilient air-absorbent material being sized for partial compression once the panels are sealed to form the envelope (see FIG. **10***a*); partially compressing the stack so as to force a portion of the gas constrained within the resilient air-absorbent material therefrom and to allow the circumferential edges of the upper and lower panels to come in contact (FIG. **10***b*); and sealing the upper and lower panels together in an air impervious seam while maintaining the stack in its partially compressed position such that an envelope is formed having a core of compressed cellular material which is partially evacuated (FIG. **10***c*). If desired, the method may further comprise the step of evacuating additional air from the envelope through a valve positioned in one of the panels. In the embodiment depicted, however, a valve is rendered unnecessary by including in the heat sealing process a buffer **104** positioned within the depending die **102** against the flat surface of the heat sealer **100** as shown in FIG. **10***b*. Buffer **104** comprises any spacer appropriately sized to compress the foam cell to a desired, evacuated thickness during the manufacturing process.

To summarize, a novel support cell/system, along with a method of manufacturing same, are described herein. Applicant's support cell/system allows greater comfort and stability, with less weight than preexisting body supporting techniques, and the has the unique feature of instantly contouring to a body to provide optimum pressure relief, but in such a way that stability is never jeopardized. This is accomplished by the unique combination of envelope overfilling and vacuum creation therein. The damped air displacement support cell/system is far superior to preexisting systems which typically suffer from wave effect and/or promote an unstable feeling when pressure is applied thereto.

Although certain preferred embodiments have been depicted and described in detail herein, it will be apparent to those skilled in the relevant art that various modifications, additions, substitutions and the like can be made without departing from the spirit of the invention, and these are therefor considered to be within the scope of the invention as defined by the appended claims.

What is claimed is:

1. A damped gas displacement support system comprising:

an envelope of flexible gas impervious material, said envelope having two substantially parallel panels of substantially the same size, each panel having a border surface, said border surfaces of said panels being sealed together in a gas impervious seam, one of said panels serving as a body supporting surface;

a core of partially compressed resilient gas-absorbent cellular material occupying the space within said envelope, said core being maintained partially compressed by the panels of said envelope; and

a gas constrained within and partially filing said cellular material, whereby said envelope immediately seeks equilibrium about that portion of an individual's body contacting the body supporting surface, and wherein the interior of said envelope is divided into multiple compartments by at least one divider wall, said compartments being occupied by said partially compressed, flexible cellular material and said gas constrained therein.

2. The damped gas displacement support system of claim **1**, wherein said resilient gas-absorbent cellular material comprises opened celled foam.

3. The damped gas displacement support system of claim **1**, wherein said resilient gas-absorbent cellular material comprises polyurethane.

4. The damped gas displacement support system of claim **1**, wherein said gas comprises air.

5. The damped gas displacement support system of claim **1**, wherein said envelope of flexible gas impervious material is manufactured of vinyl.

6. The damped gas displacement support cell of claim **1**, wherein said partial compression of said resilient gas-absorbent cellular material is in the range of 5 percent to 10 percent of said material's normal dimensions.

7. The damped gas displacement support system of claim **1**, further comprising a relatively thick casing of resilient material surrounding the envelope.

8. The damped gas displacement support system of claim **7**, wherein the casing and the envelope are adhesively attached to each other.

9. The damped gas displacement support system of claim **7**, wherein the system is a mattress.

10. The damped gas displacement support system of claim **9**, wherein said envelope having said core of compressed cellular material and said gas partially constrained therein comprises a support cell, and wherein said mattress system includes multiple support cells.

11. The damped gas displacement support system of claim **10**, wherein said mattress system includes three cells longitudinally spaced, the end cells of said mattress system being substantially identical.

12. The damped gas displacement support system of claim **11**, wherein each of said end cells is divided into multiple compartments by at least one divider wall, said compartments each being occupied by said partially compressed, flexible cellular material and said gas partially constrained therein.

13. The damped gas displacement support system of claim 7, wherein the system is a cushion.

14. The damped gas displacement support system of claim 1, further comprising a valve mounted in said envelope for communication between the interior thereof and its ambience for admitting and discharging gases.

15. The damped gas displacement support system of claim 1, wherein said compartments communicate with each other through an opening in said at least one divider wall.

16. The damped gas displacement support system of claim 1, wherein at least one of said compartments is occupied with a flexible cellular material of different density than the density of the flexible cellular material in another one of said multiple compartments.

17. A damped gas displacement support system comprising multiple support cells, each of said support cells comprising:

an envelope of flexible gas impervious material, said envelope having two substantially parallel panels of substantially the same size, each panel having a border surface, said border surfaces of said panels being sealed together in a gas impervious seam, one of said panels serving as a body supporting surface;

a core of partially compressed resilient gas-absorbent cellular material occupying the space within said envelope, said core being maintained partially compressed by the panels of said envelope;

a gas constrained within and partially filling said cellular material, whereby said envelope immediately seeks equilibrium about that portion of an individual's body contacting the body supporting surface; and

a relatively thick casing of resilient material surrounding the envelope,

wherein at least one of said multiple support cells is divided into multiple compartments by at least one divider wall, said compartments each being occupied by said partially compressed, flexible cellular material and said gas partially constrained therein.

18. The damped gas displacement support system of claim 17, wherein one of said multiple support cells comprises a center cell and wherein said center cell is divided into a plurality of compartments by divider walls, said plurality of compartments including a single lower section compartment and a plurality of upper section compartments.

19. The damped gas displacement support system of claim 18, wherein said center cell compartments are each occupied with a partially compressed, flexible cellular material having said gas partially constrained therein, the lower section compartment having a higher density cellular material therein than the material in said multiple upper section compartments.

20. The damped gas displacement support system of claim 19, wherein said center cell includes openings in said compartment defining divider walls so that said compartments communicate with each other to allow redistribution of said constrained gas when force is applied to the cell.

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UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 5,259,080

DATED : 11/09/93

INVENTOR(S) : Joseph W. Blaha

It is certified that error appears in the above-indentified patent and that said Letters Patent is hereby corrected as shown below:

In column 8, line 21, claim 1, change "filing" to --filling--.

In column 8, line 42, claim 6, change "cell" to --system--.

Signed and Sealed this

Twelfth Day of April, 1994

Attest:

BRUCE LEHMAN

Attesting Officer — *Commissioner of Patents and Trademarks*